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(54) **A press with a hydraulic cushion and a system for controlling the force and pad position thereof**

(57) A press with a hydraulic cushion with a system for controlling the force and pad position thereof, said cushion (2) having at least one hydraulic cylinder (3) with an upper chamber (4) and a lower chamber (5) and said control system comprising a control unit (6) and metering and control elements (7, 8, 9, 10, 11). Both the

pad position and force of the cushion (2) are controlled by acting on each cylinder (3), using for this purpose a single control element (7) per cylinder (3), governed by the control unit (6), which regulates the oil input and output of the lower chamber (5) of each cylinder (3), the upper chamber (4) being connected to a pressure generator set (12).

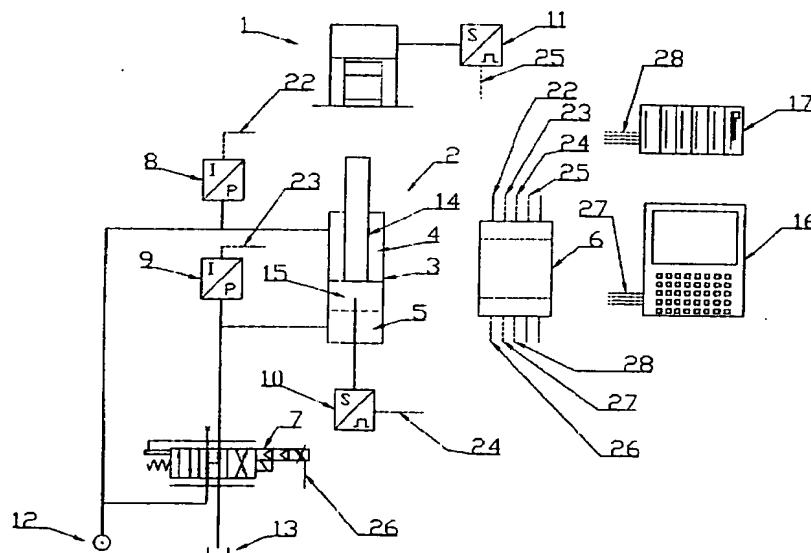


Fig. 2

## Description

### TECHNICAL FIELD

[0001] The present invention relates to presses for plate drawing and stamping and more specifically to press cushions and systems for controlling the pad position and force of said cushions when plate is drawn or stamped.

### PRIOR ART

[0002] US-5746084 discloses a press on which a cylinder with two pressure chambers is added for pre-acceleration control, said control being carried out by drawing out oil from the lower chamber by means of using a proportional valve and a metering cylinder.

[0003] In US-4896594 the pre-acceleration is also achieved by adding a pre-acceleration cylinder for this purpose.

[0004] In US-5339665 the cushion comprises a pneumatic cylinder and a hydraulic cylinder, the pre-acceleration being controlled by way of the hydraulic cylinder.

[0005] DE-3807683 describes a press that comprises a plurality of cylinder assemblies that include an axially arranged pressing cylinder and a lifting cylinder. The pressures of the pressing cylinders may be regulated individually by means of control elements and there is a control system for simultaneous movement of the lifting cylinders. The pressing cylinders are used for securing the plate during drawing and the lifting cylinders are used for raising the blank holder. This set-up permits control of cushion movement during the whole pressing process, the lifting cylinders being the ones that assist position control (during pre-acceleration, etc.) and the pressing cylinders being the ones that assist force control.

### DISCLOSURE OF THE INVENTION

[0006] The object of the invention is a press with a hydraulic cushion with a system for controlling the force and pad position thereof, as defined in the claims.

[0007] The cushion of the press of the invention comprises at least one hydraulic cylinder that has an upper chamber and a lower chamber. The control system equipping the press enables the pad position and force to be controlled throughout the pressing process by means of the use of a single control element for each hydraulic cylinder.

[0008] The function of said control element is to regulate the input and output of oil from the lower chamber of each hydraulic cylinder during pressing, both when position control is required and when force control is required.

[0009] The advantages stemming from the invention are as follows:

- Since a single control element is used per cylinder, the control system is simple.
- There is a single control system for both position and force control, the switchover between the force and position loops being performed at the right moment.
- The cylinders are the same that act both when there is force control and when there is position control, so that the number of cylinders needed is reduced.
- Closed loop force and position regulation is achieved in real time, with high speed of resolution and using sturdy control loops.
- Hydraulic and electronic simplicity are achieved.
- Compared with systems that only perform certain control functions, the system that is the object of the invention performs all the control functions needed during the pressing process.

### DESCRIPTION OF THE DRAWINGS

#### [0010]

FIG. 1 is an elevational view of an example of a press according to the invention.

FIG. 2 is a diagram of the cushion along with the elements involved in the control system thereof according to the invention.

FIG. 3 is a graph showing examples of different paths that may be followed by the cushion of the invention in the course of the pressing process.

### DETAILED EXPLANATION OF THE INVENTION

[0011] In the example in FIG. 1 the cushion 2 of the press 1 according to the invention comprises a box 21 that rests on a plurality of hydraulic cylinders 3. There is one valve 7 per said cylinder 3. The slide 29 of the press 1, which has a reciprocating up and down movement, carries the upper half of the die 18a, which, together with the lower half of the die 18b, forms plate 19. Said plate 19 is pressed by the upper half of the die 18a and the blank holder 20 during the shaping process, the effort of the cushion 2 being transmitted to the blank holder 20 by way of a plurality of pressure pins 30.

[0012] With reference to FIG. 2, each cylinder 3 has a rod 14 on which the box 21 rests and a piston 15 that defines an upper chamber 4 and a lower chamber 5. The position and force of each cylinder 3 in the course of the pressing process is controlled by means of a single control element 7 which regulates the pressure of the lower chamber 5 of each cylinder 3.

[0013] The control element 7 is governed by a control unit 6 by way of a line 26. The control unit 6 receives information on the pressure in chambers 4 and 5 of each cylinder 3, on the position of the piston 15 of each cylinder 3, and on the position of slide 29 of the press 1.

The information on the pressure in the chambers 4 and 5 is provided by the pressure transducers 8 and 9 by way of signals 22 and 23, respectively. The position transducers 10 and 11 supply, respectively, information on the position of the cylinder 3 (signal 24) and of the press 1 (signal 23).

**[0014]** The control element 7 is a valve that regulates the input and output of oil in chamber 5 by offering resistance to its flow. The outlet of the control element 7 is connected to the lower chamber 5 and its inlets are connected to a pressure generator set 12 and to a tank 13. Furthermore, the upper chamber 4 is also connected to the pressure generator set 12.

**[0015]** Besides transmitting command signal 26 to the control element 7, the control unit 6 exchanges status information with the press 1 controller 17 (line 28) and it is communicated with a user interface unit 16 (by way of a line 27). This enables the user to set up the operating and control parameters conveniently, besides performing graphic presentations and storing different working parameters.

**[0016]** Although a single cylinder 3 is shown in FIG. 2, a plurality of cylinders 3 is normally used, so that there will be a valve 7, a pair of pressure transducers 8 and 9 and a position transformer 10 per cylinder 3.

**[0017]** FIG. 3 shows some of the paths R that may be traversed by the cushion 2 in relation to the path P of the press 1 slide 29 during plate 19 pressing. These paths R are possible due to the different functions that may be performed by the control system that is the object of the invention. Said functions are, for instance, as follows:

- Height adjustment HA: it enables the user to set the height at which the cushion is going to be situated before the pressing process is started.
- Pre-acceleration PA: it enables the impact of the upper half of the die 18a with the blank holder 20 (represented in FIG. 1) to be reduced by initiating a downward movement of the cushion 2 and thereby reducing the relative speed of the upper half of the die with reference to the blank holder.
- Force Control FC: during the drawing process, and also during the upward stroke if a continuous contact between the blank holder 20 and the upper half of the die 18a is required. The retaining force may be variable in time and in space as well (by making each cylinder 3 exert a different force).
- Bottom Dead Centre Locking BDCL: it enables the cushion 2 to be held for a certain time at the position reached during drawing or even force a downstroke and locking at a level below drawing.
- Intermediate Stop Positions ISP: it enables stops to be made at programmed heights and for programmed times during the upstroke.
- Raise Speed Control RSC: it enables the speed of cushion 2 to be controlled during the upstroke.
- Stop Cushioning SC: it enables the cushion 2 to be

stopped at the upper point in a controlled way, thereby preventing sudden stops.

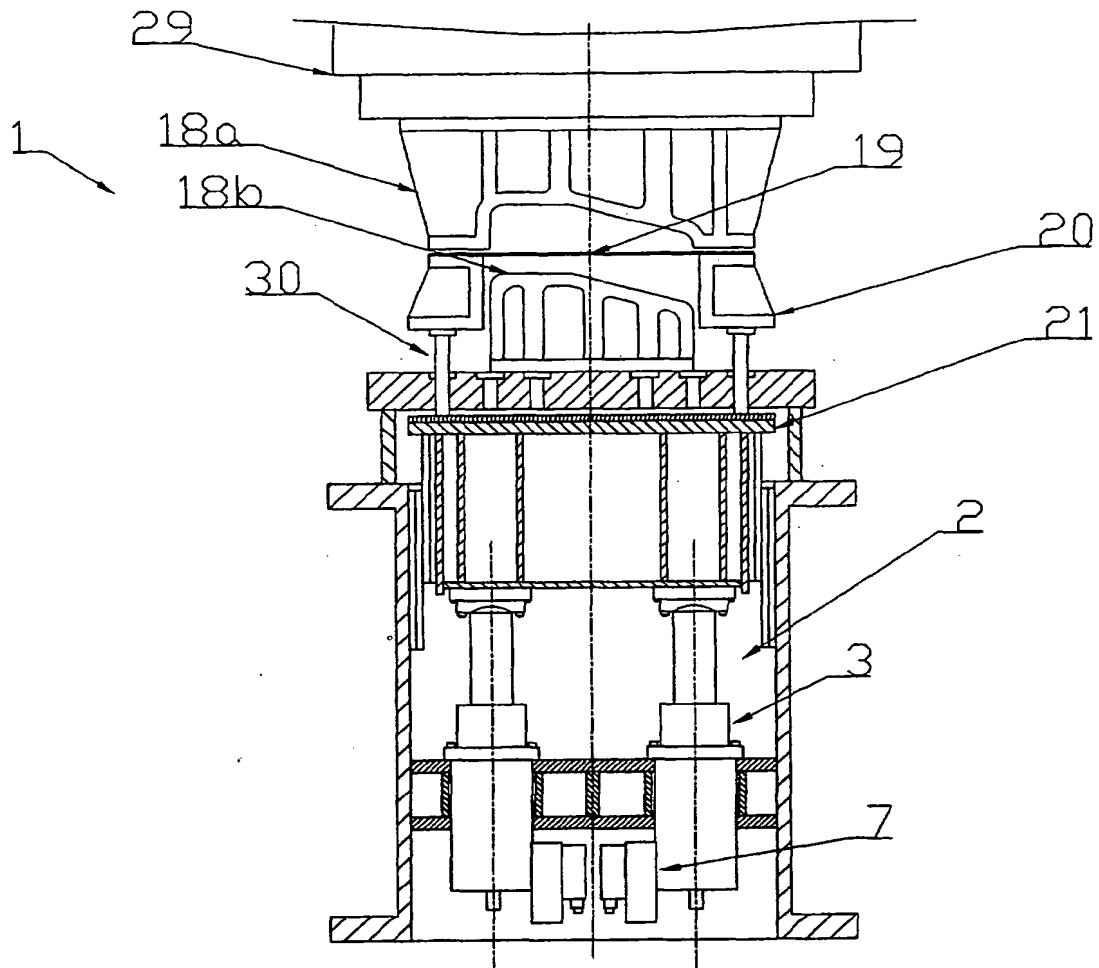
- Force Maintenance FM: in the event of press 1 stopping during the drawing process a minimum retaining force is assured.

**[0018]** There are therefore a series of functions that involve a position control of the cushion 2 (HA, PA, BDCL, ISP, and others in which force control (FC, FM) is necessary.

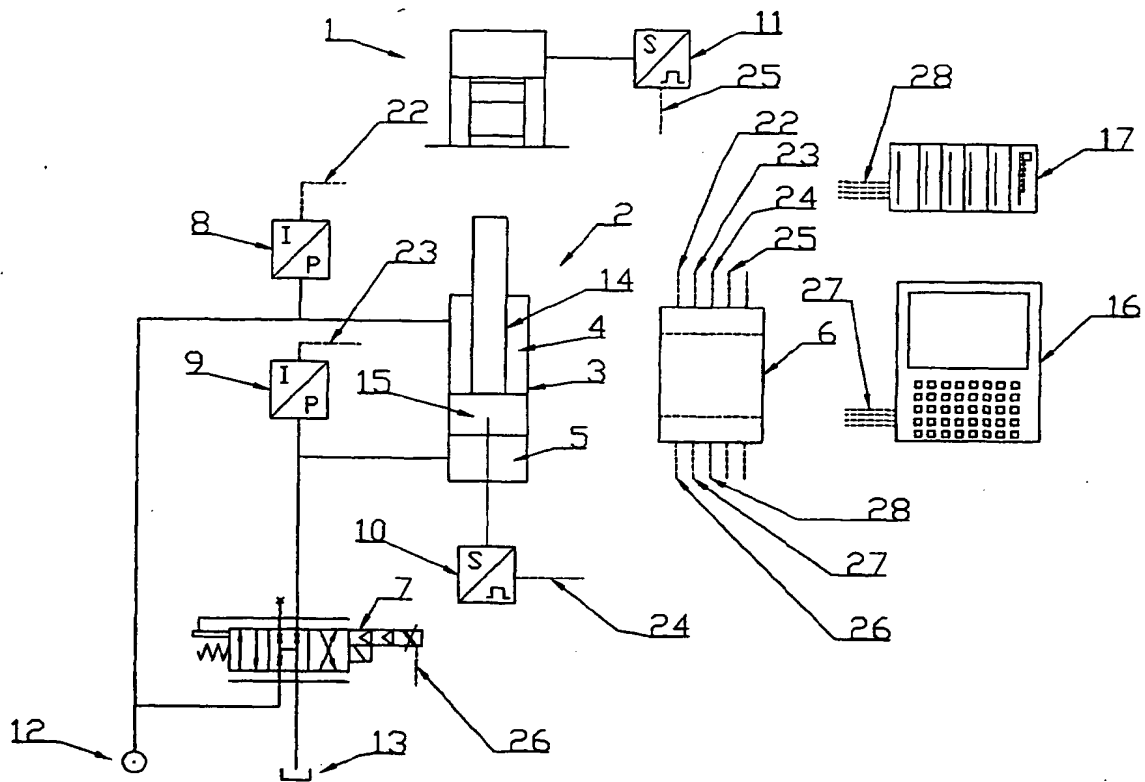
**[0019]** These functions described are illustrative examples of the types of functions that may be performed by means of position and force control, but they in no way represent a restriction on the scope of the invention, as this covers any function that may require pad position or force control.

### Claims

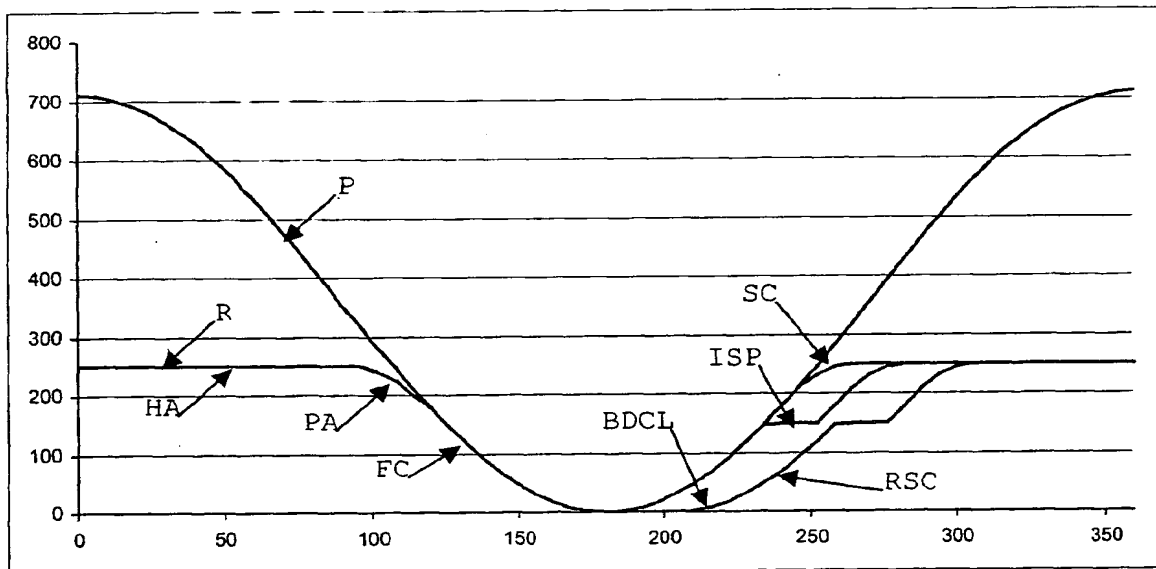
1. A press with a hydraulic cushion with a system for controlling the force and pad position thereof, said cushion (2) having at least one hydraulic cylinder (3) with an upper chamber (4) and a lower chamber (5) and said control system comprising a control unit (6) and metering and control elements (7, 8, 9, 10, 11), **characterised in that** both position and force of the cushion (2) are controlled by acting on each cylinder (3), there being used for this purpose a single control element (7) per cylinder (3), governed by the control unit (6), which regulates the oil input and output in the lower chamber (5) of each cylinder (3), the upper chamber (4) being connected to a pressure generator set (12).
2. A press according to claim 1 **characterised in that** the control element (7) is a valve that regulates oil input and output in the lower chamber (5) by offering a resistance to its flow, its outlet being connected to said lower chamber (5) and its inlets to a pressure generator set (12) and to a tank (13).



**Fig. 1**



**Fig. 2**



**Fig. 3**

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